Audit Report

OPERATIONAL TESTING AND EVALUATION OF THE
F/A-18E/F *SUPER HORNET*

Report No. 99-205 July 7, 1999

Office of the Inspector General
Department of Defense

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Acronyms

CAIG	Cost Analysis Improvement Group
COMOPTEVFOR	Commander, Operational Test and Evaluation Force
LRIP	Low-rate Initial Production

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
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July 7, 1999

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION AND TECHNOLOGY
ASSISTANT SECRETARY OF THE NAVY (FINANCIAL MANAGEMENT AND COMPTROLLER)
DIRECTOR, OPERATIONAL TEST AND EVALUATION

SUBJECT: Audit Report on Operational Testing and Evaluation of the F/A-18E/F *Super Hornet* (Report No. 99-205)

We are providing this report for your review. We conducted the audit in response to a request by Senator Russell D. Feingold.

Because this report contains no recommendations, no written comments were required, and none were received. Therefore, we are publishing this report in final form.

We appreciate the courtesies extended to the audit staff. Questions on the audit should be directed to Mr. John E. Meling at (703) 604-9091 (DSN 664-9091) (jmeling@dodig.osd.mil) or Mr. Douglas P. Neville, at (703) 604-9076 (DSN 664-9076) (dpneville@dodig.osd.mil). See Appendix G for the report distribution. The audit team members are listed inside the back cover.

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Office of the Inspector General, DoD

Report No. 99-205 **July 7, 1999**
(Project No. 9AE-0087)

Operational Testing and Evaluation of the F/A-18E/F *Super Hornet*

Executive Summary

Introduction. We conducted the audit in response to a request by the Honorable Russell D. Feingold, U.S. Senator from Wisconsin. The Senator was concerned about the quality of operational testing and evaluation provided in support of the F/A-18E/F *Super Hornet* program production decisions. He was also concerned that the Office of the Secretary of Defense might not have received timely information on the problem known as wing drop. The F/A-18E/F *Super Hornet* is a major model upgrade to the F/A-18 aircraft. It is a high-performance twin-engine, mid-wing multi-mission tactical aircraft designed to replace the F/A-18C/D *Hornet*, the A-6E *Intruder*, and the F-14 *Tomcat* aircraft.

Audit Objectives. Our objective was to evaluate and monitor the process for planning, executing, and reporting operational test results in support of the third low-rate production decision made on January 29, 1999, and in preparing for the operational evaluation that began in May 1999, for the F/A-18E/F *Super Hornet* program. We also determined when F/A-18E/F *Super Hornet* program officials provided the Office of the Secretary of Defense with timely information on the wing drop problem.

Audit Results. Overall, Navy officials planned, conducted, and reported operational test results in accordance with the procedures established in DoD regulations and Navy instructions. Further, F/A-18E/F *Super Hornet* program officials reported the in-flight phenomena known as wing drop in accordance with established risk management and deficiency reporting procedures. Specifically:

- The Commander, Operational Test and Evaluation Force, the Navy's independent test organization, appropriately planned, conducted, and reported operational test results for operational test IIB that supported the third low-rate initial production decision for the F/A-18E/F on January 29, 1999. As required, the Office of the Director, Operational Test and Evaluation, independently monitored and verified the test results, and reached the same conclusions that the Commander reported. We verified that the test results supported the conclusions and reported on the F/A-18E/F aircraft's demonstrated performance against the critical operational issues. Accordingly, we concluded that the Navy Acquisition Executive was provided with independently verified and supported operational test information for use in making the third low-rate initial production decision (finding A).

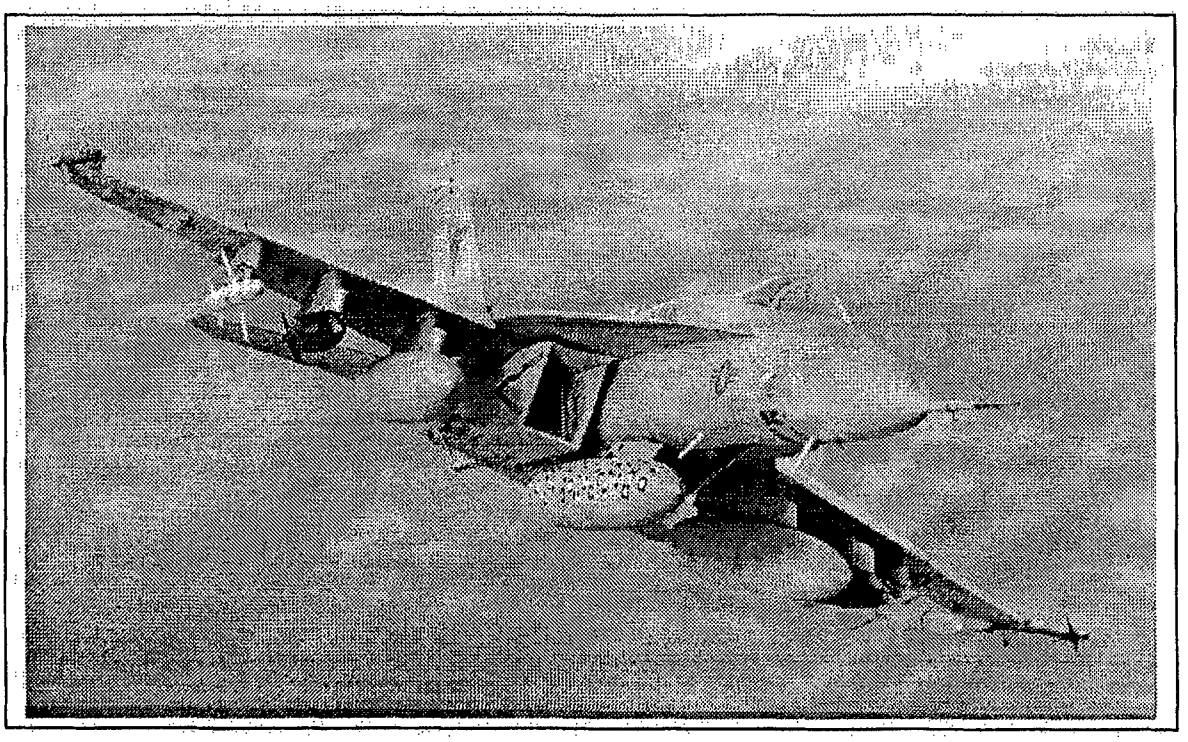
- F/A-18E/F program officials recorded, assessed, and reported the in-flight phenomena known as wing drop in accordance with DoD risk management and Navy deficiency reporting procedures. Because the Program Office believed that the wing drop problem could be successfully mitigated, based on the

history of correcting wing drop on other aircraft, it rated the wing drop problem as medium risk and did not directly disseminate the information to OSD offices with principals on the Defense Acquisition Board. However, the Offices of the Under Secretary of Defense for Acquisition and Technology, the Director, Operational Test and Evaluation, and the Director, Program Analysis and Evaluation, did learn of the wing drop problem through routine F/A-18E/F Program Office briefings before the first low-rate initial production decision. Based on the history of correcting wing drop on other aircraft, we concluded that the Program Office reasonably rated the problem as medium risk to the success to the program, properly defined and implemented risk abatement plans, and appropriately reported the wing drop problem in accordance with reporting requirements for medium-risk deficiencies identified during testing (finding B).

- The F/A-18E/F Program Office and the Commander, Operational Test and Evaluation Force, adhered to established DoD and Navy procedures for readying the program for the operational evaluation that began in May 1999. Specifically, the F/A-18E/F Program Office held the operational test readiness review and identified the impact of operational deficiencies on critical operational issues, obtained temporary waivers for uncorrected technical deficiencies identified during developmental testing, certified that the aircraft was ready for the operational evaluation, and obtained Director, Operational Test and Evaluation, approval of the detailed test plan before the operational evaluation. Although the F/A-18E/F Program Office did not resolve all deficiencies before the start of the operational evaluation, we determined that uncorrected major deficiencies going into the operational evaluation were not unusual. After reviewing the status of the unresolved major deficiencies and test limitations, we did not identify any deficiencies or limitations that would preclude the Commander from rendering an overall assessment of the operational effectiveness and suitability of the aircraft at test completion (finding C).

Management Comments. We provided a draft report on June 11, 1999. Because this report contains no recommendations, written comments were not required, and none were received. Therefore, we are publishing this report in final form.

Table of Contents



F/A-18E *Super Hornet*

Background

We conducted the audit in response to a request by the Honorable Russell D. Feingold, U.S. Senator from Wisconsin. The Senator was concerned about the quality of the operational test and evaluation provided in support of the F/A-18E/F *Super Hornet* (the F/A-18E/F) program. In addition, the Senator expressed concern that the Office of the Secretary of Defense might not have received timely information on the problem known as wing drop.

The Naval Air Systems Command estimates that research and development costs will total $5.6 billion and production costs for 548 F/A-18E/F aircraft will total $40.4 billion. The F/A-18E/F, as shown on the opposite page, an Acquisition Category IC program, is a major upgrade to the F/A-18 aircraft. The F/A-18E/F is a high-performance twin-engine, mid-wing multi-mission tactical aircraft designed to replace F/A-18C/D, A-6E, and F-14 aircraft. The F/A-18E/F will expand on the proven capabilities of the F/A-18C/D by incorporating improved engines, additional fuel volume, two additional wing stations, and upgraded flight control computer and avionics systems. The design of the multi-role F/A-18E/F has significant growth capabilities allowing for the incorporation of emerging technologies. On May 12, 1992, the Defense Acquisition Executive approved the entry of the F/A-18E/F program into the engineering and manufacturing development phase of the acquisition process.

DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System Acquisition Program (MAIS)," Change 4, May 11, 1999,[1] requires the Director, Operational Test and Evaluation, approve the adequacy of test plans before operational tests and analyze the results of operational tests and evaluations conducted for major acquisition programs. DoD Directive 5000.1, "Defense Acquisition," March 15, 1996, requires that each Military Department establish an independent operational test and evaluation activity, reporting directly to the Service chief, to plan and conduct operational tests, report test results, and provide evaluations of effectiveness and suitability.

Secretary of the Navy Instruction 5000.2B, "Implementation of Mandatory Procedures for Major and Non-Major Defense Acquisition Programs and Major and Non-Major Information Technology Acquisition Programs," December 6, 1996, designates the Commander, Operational Test and Evaluation Force (COMOPTEVFOR) as the Navy's independent operational test organization. Appendix B provides definitions of technical terms used in this report.

[1]DoD initially issued DoD Regulation 5000.2-R on March 15, 1996, and it included the Director, Operational Test and Evaluation, operational testing oversight requirements.

Objectives

Our objective was to evaluate and monitor the process for planning, executing, and reporting operational test results in support of the third low-rate initial production (LRIP) decision made on January 29, 1999, and in preparing for the operational evaluation for the F/A-18E/F program that began in May 1999. We also determined when F/A-18E/F program officials provided the Office of the Secretary of Defense with timely information on the wing drop problem. Appendix A discusses the audit scope and methodology.

A. Operational Testing Supporting the Third Low-rate Initial Production Decision

COMOPTEVFOR, the Navy's independent test organization, appropriately planned, conducted, and reported operational test results for operational test IIB that supported the third LRIP decision for the F/A-18E/F. The Director, Operational Test and Evaluation, approved the detailed test plan before COMOPTEVFOR performed the operational test. The scope of operational tests in the detailed test plan corresponded with the tests outlined in the Test and Evaluation Master Plan to support the F/A-18E/F acquisition strategy. The Office of the Director, Operational Test and Evaluation, independently monitored and verified the test results and reached the same conclusions that COMOPTEVFOR reported. We verified that the test results supported the conclusions and reported on the F/A-18E/F aircraft's demonstrated performance against critical operational issues. Accordingly, we concluded that the Navy Acquisition Executive was provided with independently verified and supported operational test information for use in making the third LRIP decision.

Requirements for Operational Test and Evaluation

United States Code. Section 2399 of title 10, United States Code, "Operational Test and Evaluation of Defense Acquisition Programs," establishes statutory requirements for operational testing of major Defense acquisition programs. Section 2399 requires that the Director, Operational Test and Evaluation, approve the adequacy of test plans before the conduct of operational tests, and analyze the results of operational tests and evaluations conducted for major acquisition programs. Section 2399 also requires that the Director submit a report to the Secretary of Defense and the congressional defense committees stating his opinion as to whether the test and evaluation performed were adequate and whether the results of such test and evaluation confirm that the systems tested actually are effective and suitable for combat.

DoD and Navy Requirements. DoD Regulation 5000.2-R requires that the Director, Operational Test and Evaluation, approve the adequacy of test plans before operational tests and analyze the results of operational tests and evaluations conducted for major acquisition programs. Secretary of the Navy Instruction 5000.2B requires COMOPTEVFOR to plan and conduct operational tests and report test results for Navy acquisition programs.

Key Milestones for the F/A-18E/F Program. As part of the F/A-18E/F requirements review process, the Joint Requirements Oversight Council validated the need to field the new capability in range and in recovery payload as soon as possible. Based on the validated need, the Defense Acquisition Executive approved the entry of the F/A-18E/F into the engineering and manufacturing development phase of the acquisition process on May 12, 1992. The Defense Acquisition Executive also approved a schedule for three LRIP lots

in three successive years. In September 1992, the Director, Operational Test and Evaluation, approved the test and evaluation master plan for the F/A-18E/F that delineated the scope of operational tests required to support the three LRIP decisions and the full-rate production decision planned for March 2000.[2] In the test and evaluation master plan, COMOPTEVFOR listed 31 critical operational issues linked to Chief Naval Operations requirements established in the F/A-18E/F operational requirements document. Appendix C lists the critical operational issues and the related operational tests that would address their resolution. As shown in Appendix C, COMOPTEVFOR planned to test for 21 of the 31 critical operational issues during operational test IIB based on the developmental configuration of the aircraft.

On March 26, 1997, the Defense Acquisition Executive approved full funding for the first LRIP buy of 12 aircraft. At the same time, the Defense Acquisition Executive delegated responsibility for future production decisions to the Navy Acquisition Executive. The Navy Acquisition Executive approved full funding for the second (20 aircraft) and third (30 aircraft) LRIP buys on April 9, 1998, and January 29, 1999, respectively.

Operational Test IIB: Planning, Conducting, and Reporting

Operational test IIB was for COMOPTEVFOR to determine the potential operational effectiveness and suitability of the F/A-18E/F aircraft and to assess progress of the aircraft toward satisfying critical operational issues. Our review showed that COMOPTEVFOR appropriately planned, conducted, and reported operational test IIB results, as specified in the test and evaluation master plan, to support the third LRIP decision for the F/A-18E/F. In addition, the Director, Operational Test and Evaluation, preapproved COMOPTEVFOR's detailed test plan for operational test IIB, monitored test conduct, and independently analyzed and reported on the test results.

Planning. On May 6, 1998, COMOPTEVFOR finalized the detailed test plan for operational test IIB that corresponded with the test requirements in the test and evaluation master plan. The detailed test plan listed seven major limitations that would affect COMOPTEVFOR's ability to fully resolve the 21 critical operational issues assessed during operational test IIB. The seven major limitations were:

- the aircraft was not production representative,
- the aircraft was not tested against current or projected threats,
- the aircraft was not tested in atmospheric conditions representative of all those in the F/A-18E/F operating environment,
- the final operating envelope of the aircraft was not fully tested,

[2]The F/A-18E/F Program Office subsequently revised the test and evaluation master plan. The current version is dated April 17, 1996.

- aircrew training and documentation was not fleet representative,
- the aircraft was maintained by the contractor, and
- the aircraft operational flight program did not support full mission system capability.

The Director, Operational Test and Evaluation, approved the detailed test plan on May 20, 1998. The Director agreed with COMOPTEVFOR that the limitations would not affect COMOPTEVFOR's ability to render a conclusion regarding the potential operational effectiveness and suitability of the F/A-18E/F that was needed to support the third LRIP decision.

Conducting. From June 1998 to August 1998, COMOPTEVFOR conducted the operational test in accordance with the test plan and evaluated F/A-18E/F performance against the 21 critical operational issues planned for assessment during operational test IIB. The action officer for the Director, Operational Test and Evaluation, along with support from a Federally Funded Research and Development Corporation, monitored COMOPTEVFOR's testing, assessed the raw test data, and discussed the test results with the Navy pilots and the COMOPTEVFOR operational test director.

Reporting. Based on the operational test IIB test results, COMOPTEVFOR and the Director, Operational Test and Evaluation, concluded and reported that the F/A-18E/F was potentially operationally effective and suitable. The Navy Acquisition Executive had COMOPTEVFOR's test report dated November 2, 1998, and the Director, Operational Test and Evaluation's independent assessment dated January 19, 1999, for use in making the third LRIP decision.

COMOPTEVFOR. In its report, COMOPTEVFOR recommended continued development of the F/A-18E/F even though the report listed 29 major deficiencies. COMOPTEVFOR noted that many of the deficiencies resulted from flying the aircraft at maneuvering and structural limits uncharacteristic for testing an engineering and manufacturing development test aircraft. As far as overall F/A-18E/F performance, COMOPTEVFOR reported that the aircraft exhibited impressive maturity and significant mission effectiveness for the engineering and manufacturing development phase. Although the report identified a significant number of major deficiencies for the Program Office to correct before the operational evaluation (operational test IIC), COMOPTEVFOR stated that the positive attributes demonstrated by the aircraft outweighed the deficiencies for all critical operational issues. Accordingly, COMOPTEVFOR concluded that the FA-18E/F was potentially operationally effective and suitable.

Director, Operational Test and Evaluation. On January 19, 1999, the Director, Operational Test and Evaluation, provided an independent assessment of the F/A-18E/F performance during operational test IIB to the Secretary of Defense and the Navy Acquisition Executive. In reference to the in-flight phenomena known as wing drop, he stated that "While the 'fix' involved more time and effort than had initially been foreseen, the wing drop phenomenon has been corrected." He also discussed technical challenges such as the towed decoy, under-wing noise and vibration, and engine issues. Notwithstanding, the

Director, Operational Test and Evaluation, stated that the testing to date indicated the F/A-18E/F program was progressing satisfactorily toward the aircraft the Department of Navy has sought.

Third LRIP Decision

On January 21, 1999, the F/A-18E/F Program Manager briefed the Navy Acquisition Executive on the readiness of the program to proceed with the third LRIP decision. The briefing agenda addressed the program's adherence to its key performance parameters and the satisfaction of exit criteria.

Status of Key Performance Parameters. A complete list of key performance parameters and status as of January 1999, is at Appendix D. As presented in Appendix D, the Program Manager showed the F/A-18E/F met or exceeded 12 of the 13 key performance parameters the Joint Requirements Oversight Council established in the operational requirements document. For the remaining key performance parameter, the Program Manager briefed that the F/A-18F aircraft did not meet the interdiction mission radius requirement because it missed the 390 nautical mile requirement by 2 nautical miles. Navy requirements officials stated that they knew of the deficiency and did not consider the difference of 2 nautical miles to be tactically significant.

Exit Criteria. A complete list of the exit criteria for the third LRIP decision and status as of January 1999, is at Appendix E. As shown in Appendix E, the F/A-18E/F Program Office satisfied the six exit criteria established for the third LRIP decision.

Independent Audit Verification

We received briefings from Naval Air Systems Command personnel on the status of the key performance parameters for the F/A-18E/F program. They explained, with documentary evidence, how the F/A-18E/F had met or exceeded all but one of the key performance parameters. We also verified that the F/A-18E/F program had satisfied the exit criteria that the Defense Acquisition Executive had established for the third LRIP decision. Further, we verified that COMOPTEVFOR followed the operational test IIB detailed test plan and that the test results supported COMOPTEVFOR's conclusions drawn and reported on the F/A-18E/F aircraft's performance against the 21 critical operational issues. The Director, Operational Test and Evaluation's test assessment was derived from the test results observed on the F/A-18E/F aircraft's performance during operational test IIB. Accordingly, we concluded that the Navy Acquisition Executive was provided with operational test information that was independently verified and supported for use in making the third LRIP decision.

B. Reporting on the Wing Drop Problem

The F/A-18E/F Program Office recorded, assessed, and reported the in-flight phenomena known as wing drop in accordance with DoD risk management and Navy deficiency reporting procedures. Because the Program Office believed that the wing drop problem could be successfully mitigated, based on the history of correcting wing drop on other aircraft, it rated the wing drop problem as medium risk and did not directly disseminate the information to OSD offices with principals on the Defense Acquisition Board. However, the Offices of the Under Secretary of Defense for Acquisition and Technology, the Director, Operational Test and Evaluation, and the Director, Program Analysis and Evaluation, did learn of the wing drop problem through routine F/A-18E/F Program Office briefings before the first LRIP decision. The Office of the Director, Operational Test and Evaluation, concurred with the Program Office's risk assessment of the wing drop problem and, accordingly, did not make an issue of it at the first LRIP decision. Based on the history of correcting wing drop on other aircraft, we concluded that the Program Office reasonably rated the problem as medium risk to the success to the program, properly defined and implemented risk abatement plans, and appropriately reported the wing drop problem in accordance with reporting requirements for medium-risk deficiencies identified during testing.

Risk Management Process and Deficiency Reporting

Program offices use the risk management process to identify and control performance, cost, and schedule risks for each acquisition program. As Program Offices identify performance deficiencies, they classify and assess the risk of the deficiencies on the overall success of their programs.

Risk Management Process. DoD Regulation 5000.2-R requires program managers to establish a risk management program to identify and control program performance, cost, and schedule risks. The regulation requires that the risk management program identify and track risk drivers, define risk abatement plans, and provide for continuous risk assessment throughout each acquisition phase.

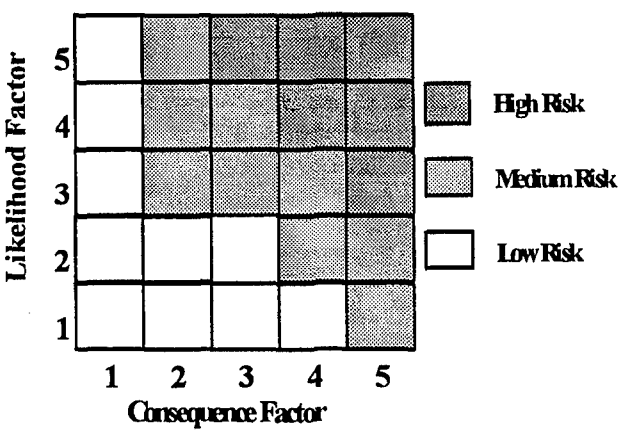
To facilitate risk management within the F/A-18E/F program, the F/A-18E/F Program Office established a Program Risk Advisory Board (Advisory Board) to evaluate the relative risk of deficiencies to the program. The Advisory Board consists of engineers and analysts from the Naval Air Systems Command, the Program Office, the Defense Contract Management Command, and contractors. The Advisory Board uses procedures established in the "F/A-18 Risk Management Plan," May 28, 1996, to identify, analyze, reduce, and track risks. Steps in the risk management process follow.

Risk Identification. Participants in the risk identification process include customers, suppliers, testers, and systems engineering personnel. From

the participants in the risk identification step, the Advisory Board produces a comprehensive list of potential technical, schedule, and cost risks effecting the program.

Risk Analysis. In the risk analysis step, the Advisory Board assesses each of the two components of risk, the likelihood that the risk will occur and the consequence to the program should it occur. The Advisory Board considers the likelihood and consequence factors independently and maps its assessment into a risk grid to determine the individual risk level to assign to each potential technical, schedule, and cost risk affecting the program.

RISK GRID



Based on the assigned likelihood and consequence factors, the Advisory Board rates program technical, schedule, and cost deficiencies as high, medium, or low risk. The Advisory Board assigns high risk to a deficiency that will likely cause significant disruption of schedule, increase in cost, or degradation of performance. The Advisory Board assigns medium risk to a deficiency that may cause some disruption of schedule, increase in cost, or degradation in performance. The Advisory Board assigns low risk to a deficiency that has little or no potential for program disruption.

Risk Reduction. In the risk reduction step, the Advisory Board implements appropriate and cost-effective risk reduction plans to reduce or eliminate risks. In developing a risk reduction plan, the Advisory Board includes an assessment of the expected outcome following plan implementation.

Risk Tracking. The Advisory Board tracks each step of the risk reduction process and updates the deficiency risk rating up or down as required. In assessing the need to review the deficiency risk rating, the Advisory Board compares the actual performance of the risk reduction plan to the expected outcome following plan implementation.

Deficiency Reporting. The F/A-18E/F Program Office uses a systematic approach to identify potential problems, document anomalies and discrepancies in the systems still under development, and report and update the status of the deficiencies. Test personnel document anomalies and discrepancies observed

during testing as watch items for initial screening. The F/A-18E/F integrated test team reviews the watch items weekly and elevates watch items to white sheets when the anomalies and discrepancies:

- have no fix identified,
- have failed a reevaluation,
- impact a significant flight test event, or
- have no verification fix available during engineering and manufacturing development.

A Deficiency Report Review Board, chaired by the Government Flight Test Director, reviewed the white sheets periodically, initially quarterly and then monthly, to determine the need to elevate the white sheets to a deficiency report. The Review Board elevates an anomaly or discrepancy to a deficiency report when:

- a fix continues to elude the Program Office,
- an identified fix fails a second retest,
- the Program Office needs excessive time to develop a correction, or
- a verification fix is not available during engineering and manufacturing development.

The Program Office uses an electronic database, the Deficiency Database Management System, to document the watch items, white sheets, and deficiency reports. Government and contractor program personnel have access to the database to track the status of the watch items, white sheets, and deficiency reports. Access to the database also enables the Program Manager to have necessary insight into technical issues effecting flight tests.

Wing Drop on the F/A-18E/F

The Program Office managed the in-flight phenomena known as wing drop in accordance with Navy procedures for recording, classifying, resolving, and reporting identified deficiencies. Wing drop is an uncommanded abrupt rolling motion that often occurs at transonic maneuvering conditions and seriously degrades the pilot's tracking capability. Wing drop results from asymmetric flow separation on the wing upper surface and produces aircraft high roll rates and large bank angle changes. Once the test pilot discovered and recorded wing drop during F/A-18E/F developmental testing, the Advisory Board and the Program Office followed risk management procedures for defining and implementing risk abatement plans, and for reassessing the need to revise the risk rating assigned to the wing drop problem. Wing drop has occurred on several previous aircraft including the F-4 *Phantom*, the F-15 *Eagle,* and the AV-8B *Harrier.*

Recording. The pilot of a F/A-18E developmental test aircraft reported the uncommanded wing rock, now known as wing drop, as a watch item on March 11, 1996. The pilot described the mission impact as "degraded A/A [air-to-air] tracking." Developmental test personnel investigated the nature and characterization of wing drop to assess its risk and to apply potential solutions.

On June 11, 1996, the F/A-18E/F Government flight test director elevated the watch item to a white sheet because fixes, such as a revised leading edge flap schedule (software fix) only resolved about 80 percent of the wing drop problem. In the white sheet, the Government flight test director stated that the problem prevented or severely restricted the performance of air-to-air tracking tasks during air-to-air combat maneuvering. After additional attempts to further resolve the wing drop problem were not successful, the Government flight test director elevated the status of the wing drop problem to a formal deficiency on October 10, 1996.

Classifying. On May 30, 1996, the Advisory Board assigned a medium-risk rating to the anomaly. Using the risk grid, the Advisory Board assigned a likelihood factor of 4 and a consequence factor of 3. The Program Risk Advisory Board assigned a medium-risk rating because, based on the history of wing drop on other aircraft and the software intensive nature of the F/A-18E/F, it believed that the problem could be resolved with minimal impact on program cost and schedule.

The Advisory Board reexamined the wing drop deficiency on February 25, 1997, just before the Defense Acquisition Board reviewed the readiness of the F/A-18E/F to proceed with the first LRIP decision in March 1997. The Advisory Board still rated the wing drop problem as medium risk. Wing drop was but one of many technical deficiencies that test personnel identified and the Advisory Board rated as medium risk.

Resolving. By applying a variety of potential solutions, the Program Office discovered a combination of fixes that controlled the wing drop problem. The working assumption was that the uncommanded abrupt rolling motion was caused by rapid, asymmetric flow separation (stall) between the left and right wings. Early efforts at solving wing drop focused on modifying the wing control surface schedules (software fix) to either prevent flow separation or delay the separation to higher angles of attack. Through the software fixes, the Program Office successfully mitigated about 80 percent of the wing drop impact on aircraft performance by March 1997.

In December 1997, the Program Office chartered a Blue Ribbon panel consisting of experts from private industry and academia, as well as the Federal Government to confirm that it was approaching the wing drop problem effectively. In the January 14, 1998, report, the panel concluded that the wing drop problem was "not atypical" for this type of high-performance aircraft development program. The panel also stated that the wing drop problem could not have been predicted prior to flight test. Moreover, the panel agreed with the Program Office's near-term flight test plans to resolve the problem. The panel recommended that the Department of Defense initiate a cooperative research effort with the National Aeronautics and Space Administration to study the wing

drop problem thoroughly and systematically. In response, the Office of the Secretary of Defense established a symposium to study the cause of wing drop.

To mitigate the remaining 20 percent of the wing drop impact, program officials expanded the wing drop solution to include hardware modifications to the basic airframe. The Program Office flight-tested several flow control mechanisms, such as stall strips, vortex generators, and a wing fence, either individually or in combination. Ultimately, none of the flow control configurations eliminated wing drop without unacceptably degrading at least one other aspect of the aircraft's performance or flying qualities. After additional testing, Boeing Corporation engineers applied a porous wing fold fairing fix to the aircraft in July 1998. Although the porous wing fold fairing worked to control the wing drop problem, it also increased aircraft buffet levels. Buffet is a vibration in an aircraft that is analogous to a ground vehicle riding on a gravel road. During subsequent developmental tests, pilots indicated that the increase in buffet was acceptable and that the fix did not adversely effect the aircraft's mission performance.

Reporting. The Defense Acquisition Board, chaired by the Defense Acquisition Executive, reviewed the readiness of the F/A-18E/F program to proceed with the first LRIP decision in March 1997. Within the Office of the Secretary of Defense, principal members on the Defense Acquisition Board include the Vice-Chairman of the Joint Chiefs of Staff; the Principal Deputy Under Secretary of Defense for Acquisition and Technology; the Under Secretary of Defense (Comptroller); the Assistant Secretary of Defense (Strategy and Requirements); the Director, Operational Test and Evaluation; and the Director, Program Analysis and Evaluation. At least three of the offices with principals on the Defense Acquisition Board knew of the wing drop problem before the Defense Acquisition Executive made the first LRIP decision on March 26, 1997. Specifically, we interviewed representatives from five of the offices that have principals on the Defense Acquisition Board. Officials in offices of the Under Secretary of Defense for Acquisition and Technology, the Director, Operational Test and Evaluation, and the Office of the Director, Program and Evaluation, stated that they knew of wing drop before the LRIP decision. Representatives from the office of the Under Secretary of Defense (Comptroller) and another office of the Under Secretary of Defense for Acquisition and Technology (Director, Strategic and Tactical Systems) could not recall when they first became aware of the wing drop problem.

Office of the Director, Test Systems Engineering and Evaluation. The Principal Assistant, Systems Assessment, within the Office of the Director, Test Systems Engineering and Evaluation, Under Secretary of Defense for Acquisition and Technology, stated that his office first became aware of wing drop when the Program Risk Advisory Board first assigned a medium risk to the anomaly in May 1996. The Principal Assistant stated that his office routinely received copies of the risk assessments developed by the Advisory Board. He did not raise the issue with the Defense Acquisition Board because he believed that the F/A-18E/F Program Office was appropriately managing the risk.

Office of the Director, Operational Test and Evaluation. The action officer within the Office of the Director, Operational Test and Evaluation, stated that he became aware of the wing drop problem in early February 1997, based

on a pilot briefing provided to the F/A-18E/F Program Manager. On February 4, 1997, the action officer prepared a written program assessment that documented the Program Office's attempts to resolve the wing drop problem. Because the action officer had an aviation background, he was able to quickly understand and independently assess the potential affect of the wing drop problem on the F/A-18E/F program. He concluded that the problem was not a significant program risk and did not highlight the problem to the Director, Operational Test and Evaluation, for discussion at the Defense Acquisition Board program review.

Cost Analysis Improvement Group. Several Cost Analysis Improvement Group (CAIG) representatives within the Office of the Director, Program Analysis and Evaluation, indicated that they were aware of the wing drop problem as early as December 1996. Also, the CAIG had retained Program Office briefing charts that showed that the CAIG was briefed on the wing drop problem in February 1997. Because the CAIG officials did not fully understand the technical implications of the wing drop problem, they also did not raise it as a concern with the Director, Program Analysis and Evaluation, before the first LRIP review.

In summary, the F/A-18E/F Program Office did not directly disseminate the information to other OSD offices with principals on the Defense Acquisition Board because the Program Office believed that the wing drop problem could be successfully mitigated based on the history of correcting wing drop on other aircraft. Accordingly, it rated the problem as medium risk. As a result, the Program Manager briefed the wing drop problem to OSD officials as part of routine briefings and placed no special emphasis on the wing drop problem.

Status of Wing Drop

The Advisory Board reassessed the wing drop problem for the final time on May 18, 1998. It assigned a likelihood factor of 3 and a consequence factor of 4, which equates to a medium-risk determination on the risk grid. The assessment stated that "the mitigation plans have been followed through and a solution has been found for the wing drop problem." As a result, the Advisory Board concluded that no further technical risk assessments on the wing drop problem were needed.

Our engineer independently reviewed the process for identifying and resolving the wing drop problem. Our engineer concluded that the wing drop appeared to be properly characterized and rated as medium risk.

In July 1998, Boeing Corporation engineers installed a production representative porous wing fairing on the test aircraft to mitigate the wing drop effects. Based on subsequent developmental test and evaluation, the Government flight test director concluded that the contractor had resolved the wing drop problem.

COMOPTEVFOR conducted operational test IIB from June to August 1998. Although the detailed test plan included seven major flight limitations as discussed in Finding A, none of the limitations precluded the operational test pilots from flying in the flight envelopes associated with the wing drop problem.

During the test, the operational test pilots looked for, but did not observe, a recurrence of the wing drop problem.

As of May 1999, the Program Office has essentially eliminated the impacts of the wing drop problem. As a result, the problem no longer threatens the performance of the F/A-18E/F aircraft. However, the Program Office is still pursuing an optimum fix, which will eliminate the aircraft buffeting as well.

Conclusion

The Program Office adhered to DoD risk management and Navy deficiency reporting procedures for recording, assessing, and reporting the F/A-18E/F aircraft wing drop problem. The wing drop problem was just one of many deficiencies that developmental and operational testers identified and the Advisory Board rated as medium risk. The Advisory Board did not consider the wing drop problem as a high-risk problem because of previous history of wing drop problems on other developmental aircraft and the software intensive nature of the F/A-18E/F aircraft. As a result, the Program Manager did not directly disseminate information on the wing drop problem as well as other medium-risk items affecting the program to the principal members of the Defense Acquisition Board. Office of the Director, Operational Test and Evaluation personnel who did learn of the wing drop through routine pilot briefings also did not consider the wing drop problem as a high-risk item affecting the program. Further, they stated that the Program Office openly discussed the wing drop problem and the actions to resolve it. Accordingly, we concluded that the Program Office reported the wing drop problem in accordance with Navy procedures for resolving and reporting a technical deficiency that was rated as medium risk.

C. Preparation for the Operational Evaluation

The F/A-18E/F Program Office and COMOPTEVFOR adhered to established DoD and Navy procedures for readying the program for the operational evaluation that began in May 1999. Specifically, the F/A-18E/F Program Office:

- resolved 8 of the 29 major deficiencies identified during earlier operational testing and implemented actions to resolve the remaining 21 deficiencies;
- held the operational test readiness review and identified the impact of the remaining 21 major deficiencies on resolving the 31 critical operational issues;
- obtained temporary waivers for uncorrected technical deficiencies identified during developmental testing from the Director, Air Warfare Division, Office of the Deputy Chief of Naval Operations (Resources, Warfare Requirements, and Assessments) before the start of the operational evaluation; and
- certified that the F/A-18E/F aircraft was ready for operational testing subject to certain test limitations.

As required, the Director, Operational Test and Evaluation, approved COMOPTEVFOR's detailed test plan before the start of the operational evaluation. Although the Program Office did not resolve all deficiencies before the start of the operational evaluation, we determined that uncorrected major deficiencies going into the operational evaluation were not unusual. After reviewing the status of the unresolved major deficiencies and test limitations, we did not identify any deficiencies or limitations that would preclude COMOPTEVFOR from rendering an overall assessment of the operational effectiveness and suitability of the aircraft at the test completion.

Operational Evaluation Requirements

DoD Requirements. Before a major Defense acquisition program enters full-rate production, DoD Regulation 5000.2-R requires the Director, Operational Test and Evaluation, to submit a beyond low-rate initial production report to the Secretary of Defense and the Congress. In the report, the Director is to assess the adequacy of the operational evaluation conducted and whether the test results confirmed that the system tested is operationally effective and suitable for use in combat. In preparation for the operational evaluation, the regulation requires that:

- the F/A-18E/F Program Office certify that the system is ready for the dedicated phase of operational test and evaluation that COMOPTEVFOR will conduct, and

- the Director, Operational Test and Evaluation, approve the adequacy of COMOPTEVFOR's detailed operational test plan before test conduct.

Navy Requirements. In addition to requirements in DoD Regulation 5000.2-R, Navy Instruction 5000.2B requires that the Program Office perform the following activities before certifying that the system is ready for the dedicated phase of operational test and evaluation:

- resolve significant deficiencies identified in earlier developmental tests,

- hold an operational test readiness review to brief the Program Executive Officer, Navy requirements officials, Naval Air Systems Command officials, and COMOPTEVFOR on the impact of uncorrected major deficiencies and test limitations on COMOPTEVFOR's ability to address critical operational issues during the test, and

- obtain temporary waivers of uncorrected technical deficiencies identified during developmental testing from the Director, Air Warfare Division, Office of the Deputy Chief of Naval Operations (Resources, Warfare Requirements, and Assessments) before the start of the operational evaluation.

Operational Evaluation Preparation

Before the operational evaluation, COMOPTEVFOR prepared and the Director, Operational Test and Evaluation, approved the detailed test plan. Also, the Program Office held the operational test readiness review, obtained waivers for uncorrected technical performance deficiencies, and certified the system as ready for the operational evaluation.

Detailed Test Plan. On March 16, 1999, COMOPTEVFOR submitted the detailed test plan for the F/A-18E/F operational evaluation to the Director, Operational Test and Evaluation, for approval. In the detailed test plan, COMOPTEVFOR listed one limitation that would preclude it from resolving the critical operational issue for reconnaissance and three other limitations that would not affect its ability to resolve the remaining 30 critical operational issues. The critical operational issue for reconnaissance would not be assessed because the tactical reconnaissance sensor suite was not cleared for employment during the operational evaluation. The other three limitations were: all weapons combinations would not be cleared for carriage and release, the aircraft would not be fully tested in all natural operating environments, and simulated threats may not fully replicate the projected threat. COMOPTEVFOR

concluded that the limitations would not affect its ability to draw a conclusion regarding the operational effectiveness and operational suitability of the F/A-18E/F aircraft.

The Director, Operational Test and Evaluation approved the detailed test plan on April 22, 1999.

Operational Test Readiness Review. The Program Office certified the F/A-18E/F program ready for operational evaluation at the operational test readiness review held during the week of April 26, 1999. Attendees at the operational test readiness review included the Office of the Director, Operational Test and Evaluation; the Program Executive Officer (Tactical Aircraft Programs); the Director, Air Warfare Division, Office of the Deputy Chief of Naval Operations (Resources, Warfare Requirements, and Assessments); the Assistant Commander for Research and Engineering, Naval Air Systems Command; the Director, Navy Test and Evaluation and Technology Requirements; and COMOPTEVFOR. The Program Office briefed the attendees on the program's adherence to its key performance parameters and the status of correcting the major deficiencies identified in previous operational tests.

Status of Key Performance Parameters. The F/A-18E/F Program Manager briefed that the F/A-18E aircraft was meeting all of its key performance parameters and that the F/A-18F aircraft was meeting all but one of its key performance parameters. The F/A-18F aircraft did not meet the key performance parameter for interdiction mission radius, which the aircraft's performance missed by two nautical miles. During developmental testing conducted in March 1999 and demonstrated aboard the *USS Harry S Truman*, he stated that the developmental test results indicated that the interdiction mission radius shortfall for the F/A-18F aircraft could be eliminated based on a performance evaluation aboard ship. Specifically, the testers demonstrated that the interdiction mission for the F/A-18E/F aircraft could be launched in the military power rather than the afterburner power setting. Before this demonstration, the Program Office assumed the more conservative prediction based on the F/A-18E/F aircraft being launched in the afterburner power setting.

Resolution of Operational Test Deficiencies. The F/A-18E/F Program Manager presented solutions for the 29 major deficiencies identified during previous operational test. Of the 29 deficiencies, the Program Manager stated that the F/A-18E/F was not designed to correct 3 legacy issues remaining from the F/A-18C/D aircraft program. Instead, the Navy is addressing two of the legacy issues concerning air-to-ground and air-to-air sensor performance through separate development efforts for the Advanced Tactical Forward-Looking Infra-Red and the Active Electronically Scanned Array programs. The Navy plans to deploy the two development efforts in 2002 and 2005, respectively. The Navy is addressing the third legacy issue that also affects air-to-air sensor performance through a fix of the operational flight program. Of the remaining 26 major deficiencies, the Program Office resolved 8 and plans to fully resolve the remaining 18 before COMOPTEVFOR completes follow-on operational test and evaluation scheduled to begin in June 2000. Program Office engineers indicated that solutions to correct some major deficiencies involved

developing tactics to further optimize aircraft performance and other solutions involved software changes. See Appendix F for the status of resolving the 29 major deficiencies identified during earlier operational tests.

The Program Manager openly critiqued and rated each uncorrected major deficiency at the operational test readiness review. COMOPTEVFOR, in turn, articulated the potential impact of each deficiency on its ability to resolve the respective critical operational issues. In summary, the 21 uncorrected major deficiencies will impact COMOPTEVFOR's ability to fully resolve 11 of the 31 critical operational issues during the operational evaluation.

Completion of Other Actions. On May 21, 1999, the Program Executive Officer (Tactical Aircraft Programs) certified that the F/A-18E/F aircraft was ready for operational evaluation. On May 24, 1999, the Director, Air Warfare Division, Office of the Deputy Chief of Naval Operations (Resources, Warfare Requirements, and Assessments) approved the temporary waivers of 49 uncorrected technical deficiencies identified during developmental testing. Accordingly, COMOPTEVFOR began the operational evaluation on May 27, 1999.

Conclusion

At the time the operational evaluation began in May 1999, the F/A-18E/F Program Office was still in the process of correcting 21 major deficiencies identified during earlier operational tests. Ideally, a program would proceed into operational evaluation with no uncorrected deficiencies. However, the presence of uncorrected major deficiencies going into the operational evaluation is not unusual. Our engineer reviewed the process the Program Office used to resolve the deficiencies and concluded that the Program Office was taking appropriate resolution actions. Further, our engineer did not identify any deficiencies or test limitations that would preclude COMOPTEVFOR from rendering an overall assessment of the operational effectiveness and suitability of the aircraft at the test completion.

Appendix A. Audit Process

Scope and Methodology

We reviewed DoD and Navy's policies and procedures for planning, conducting, and reporting operational test results. We also reviewed the Office of the Director, Operational Test and Evaluation, actions for approving detailed operational test plans, for monitoring operational tests conducted, and analyzing test results before LRIP decisions for the F/A-18E/F program. Additionally, we reviewed COMOPTEVFOR actions for preparing detailed operational test plans, conducting operational tests, and reporting test results from September 1997 through April 1999.

To determine when F/A-18E/F program officials provided the Office of the Secretary of Defense with information on the wing drop problem, we interviewed individuals within the Offices of the Secretary of Defense, the F/A-18E/F Program Office, COMOPTEVFOR, and the Boeing Corporation. Further, we reviewed the F/A-18E/F Program Office's implementation of DoD's risk management process and the Navy's deficiency reporting procedures.

To assess the F/A-18E/F aircraft's readiness for the operational evaluation, we reviewed the detailed test plan, the conduct of the operational test readiness review, the approval of temporary waivers for uncorrected technical deficiencies, and the certification of readiness for operational testing that were prepared before the start of the operational evaluation. We also reviewed the major deficiencies identified during earlier operational tests of the F/A-18E/F aircraft and evaluated actions of the F/A-18E/F Program Office to resolve the major deficiencies.

DoD-wide Corporate-Level Government Performance and Results Act Goals. In response to the Government Performance and Results Act, the Department of Defense established 6 DoD-wide corporate level performance objectives and 14 goals for meeting the objectives. This report pertains to achievement of the following objective and goal.

> **Objective:** Prepare now for an uncertain future. **Goal:** Pursue a focused modernization effort that maintains U.S. qualitative superiority in key warfighting capabilities. **(DoD-3)**

General Accounting Office High-Risk Area. The General Accounting Office identified several high-risk areas in DoD. This report provides coverage of the Defense Weapons Systems Acquisition high-risk area.

Use of Computer-Processed Data. We did not use computer-processed data to perform this audit.

Use of Technical Assistance. We obtained technical support from an Aerospace Engineer assigned to the Mechanical Engineering Branch, Technical

Assessment Division, Audit Followup and Technical Support Directorate of the Office of the Assistant Inspector General for Auditing, DoD.

Audit Period and Standards. We performed this requested audit from January 1999 through May 1999 and reviewed data from May 1992 through May 1999. We conducted this program audit in accordance with auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD. The scope of the audit was limited in that we did not review the management control program.

Contacts During the Audit. We visited or contacted individuals and organizations within DoD, the General Accounting Office, the Institute for Defense Analysis, and the Boeing Corporation. Further details are available upon request.

Management Control Program Review

The scope of this audit was limited to the operational test and evaluation process and the wing drop deficiency. Specifically, we reviewed the management controls for the planning, conducting, and reporting of operational tests for the F/A-18E/F and found the management controls adequate.

Summary of Prior Coverage

During the last 5 years, the General Accounting Office has issued three reports discussing the F/A-18E/F program.

General Accounting Office Report No. NSIAD-99-127 (Office of the Secretary of Defense Case No. 1792), "Defense Acquisitions: Progress of the F/A-18E/F Engineering and Manufacturing Development Programs," June 15, 1999.

General Accounting Office Report No. NSIAD-98-61 (Office of the Secretary of Defense Case No. 1517), "Navy Aviation: F/A-18E/F Development and Production Issues," March 13, 1998.

General Accounting Office Report No. NSIAD-96-98 (Office of the Secretary of Defense Case No. 1125), "Navy Aviation: F/A-18E/F Will Provide Marginal Operational Improvement at High Cost," June 18, 1996.

Appendix B. Definition of Technical Terms

Acquisition Category. An attribute of an acquisition program that determines the program's level of review, decision authority, and applicable procedures. The acquisition categories consist of I, major Defense acquisition programs; IA, major automated information systems; II, major systems; and III, all other acquisition programs. In addition acquisition category I programs have two subcategories: acquisition category ID are programs where the milestone decision authority is the Under Secretary Defense (Acquisition and Technology), and acquisition category IC are programs where the milestone decision authority is the Component Acquisition Executive.

Afterburner. Power setting equivalent to the maximum augmented thrust at standard day conditions.

Buffet. Buffet is a vibration in an aircraft that is analogous to riding a ground vehicle on a gravel road.

Critical Operational Issue. Critical operational issues are critical aspects of a system's operational effectiveness and operational suitability that COMOPTEVFOR intends to assess during operational test and evaluation.

Defense Acquisition Board. The Defense Acquisition Board is the Defense Department's senior-level forum for advising the Defense Acquisition Executive on making program milestone decisions for acquisition category ID programs.

Deficiency Report. The Program Office's Government flight test director elevates an anomaly report from a "white sheet" to a deficiency report when:

- a fix continues to elude the Program Office,
- an identified fix fails a second retest,
- the Program Office needs excessive time to develop a correction, or
- a verification fix is not available during engineering and manufacturing development phase of the acquisition process.

Exit Criteria. Exit criteria are program specific accomplishments that must be satisfactorily demonstrated before a program can progress further in the current acquisition phase or transition to the next acquisition phase.

Engineering and Manufacturing Development. Engineering and manufacturing development is the third phase of the acquisition process where the Program Office fully develops, engineers, designs, fabricates, tests, and evaluates the system and the principal items necessary for its support.

Follow-on Operational Test and Evaluation. Follow-on operational test and evaluation is test and evaluation that is necessary during and after the production period to refine the performance estimates made during operational test and

evaluation, to evaluate changes, and to reevaluate the system to ensure that it continues to meet operational needs and retains its effectiveness in a new environment or against a new threat.

Full-Rate Production. Full-rate production is contracting for economic production quantities following stabilization of the system design and validation of the production process.

Initial Operational Test and Evaluation. Initial operational test and evaluation is all operational test and evaluation conducted on production or production-representative articles to support a decision for a system to proceed beyond LRIP.

Joint Requirements Oversight Council. The Joint Requirements Oversight Council is responsible to the Chairman of the Joint Chiefs of Staff for assessing military requirements in support of the defense acquisition process. The Vice-Chairman of the Joint Chiefs of Staff chairs the Council.

Key Performance Parameter. Key performance parameters are capabilities or characteristics that the Joint Requirements Oversight Council designates as so significant that failure to meet the threshold value can cause the concept or system selected to be reevaluated or the program to be reassessed or terminated.

Legacy Issue. A legacy issue is an uncorrected deficiency remaining from a previous model of the F/A-18 aircraft (F/A-18C/D) that was carried forward to the F/A-18E/F.

Low-rate Initial Production. Low-rate initial production is the production of a system in limited quantities to provide articles for additional operational test and evaluation, to establish an initial production base, and to permit an orderly increase in the production rate sufficient to lead to full-rate production upon successful completion of operational testing.

Major Deficiency. A major deficiency is an operational mission failure or software fault that precludes successful completion of the intended mission of the system.

Military Power. Power setting equivalent to the maximum nonaugmented thrust at standard day conditions.

Operational Effectiveness. Operational effectiveness is the overall degree of mission accomplishment of a system when used by representative personnel in the environment planned or expected for operational employment of the system considering organization, doctrine, tactics, survivability vulnerability, and threat.

Operational Evaluation. The operational evaluation is the last phase of initial operational test and evaluation, a prerequisite for a system to proceed to a full-rate production decision.

Operational Suitability. Operational suitability is the degree to which a system can be placed satisfactorily in field use with consideration given to reliability,

maintainability, availability, logistic supportability, compatibility, interoperability, training, human factors, safety, documentation, transportability, wartime usage rates, manning requirements, and natural and environmental effects and impacts.

Operational Test and Evaluation. Operational test and evaluation is conducted to determine a system's operational effectiveness and operational suitability, identify system deficiencies, and the need for potential modifications to meet established operational test and evaluation minimum acceptable operational performance requirement and develop tactics.

Test and Evaluation Master Plan. The test and evaluation master plan documents the overall structure and objectives of the test and evaluation program. It provides a framework within which to generate detailed test and evaluation plans and it documents schedule and resource implications associated with the test and evaluation program.

Tracking. Tracking refers to a pilot's ability to observe or plot the moving path of a missile or aircraft.

Watch Item. A program official prepares a developmental test watch item that documents when a significant anomaly requires management attention, a significant anomaly has bubbled-up from individual databases, or an anomaly requires design or software change.

White Sheet. The Program Office's Government flight test director prepares a developmental test white sheet that documents when an anomaly has no fix identified, has failed reevaluation, impacts a significant flight test event, or a verification fix is not available during engineering and manufacturing development.

Appendix C. Critical Operational Issues

COMOPTEVFOR identified 31 critical operational issues in the Test and Evaluation Master Plan for the F/A-18E/F aircraft. Of the 31 critical operational issues, 21 involved effectiveness issues and 10 involved suitability issues.

	Operational Test		
Effectiveness Issues	IIA	IIB	IIC
Interdiction Mission	x	x	x
War-at-Sea Mission	x		x
Fighter Escort Mission	x	x	x
Combat Air Patrol Mission	x	x	x
Deck-Launched Interceptor			x
Air Combat Maneuvering		x	x
Defense Suppression		x	x
Close Air Support	x	x	x
Forward Air Controller (Airborne)		x	x
Reconnaissance Mission			
Tanker Mission			x
Air-to-Ground Sensor Performance	x	x	x
Air-to-Ground Weapons	x	x	x
Air-to-Air Sensor Performance	x	x	x
Air-to-Air Weapons		x	x
Tactics	x	x	x
Survivability	x	x	x
Command, Control and Communications	x	x	x
Mine Warfare Mission			x
Mobility Mission	x	x	x
Joint Interoperability			x
Suitability Issues			
Reliability			x
Maintainability	x	x	x
Availability			x
Logistic Supportability		x	x
Compatibility	x	x	x
Interoperability		x	x
Training			x
Human Factor	x	x	x
Safety	x	x	x
Documentation			x

x - Denotes that COMOPTEVFOR addressed the critical operational issue during the indicated operational test.

Appendix D. Key Performance Parameters

Status as of December 1998

Performance Characteristic	Objective	Threshold	Demonstrated Performance[1] F/A-18E	F/A-18F
Deck Spot Factor (F/A-18A/B/C/D=1.2)[2]	≤1.4	<1.5	1.46	1.46
Fighter Escort Radius (Internal Fuel)[3] (nm)	≥425	≥410	459	---
Interdiction Mission Radius[4]				
2-480 Gallon External Tanks (Retained) (nm)	≥400	≥390	432	388
3-480 Gallon External Tanks (Retained) (nm)	≥450	≥430	498	455
Combat Ceiling (Maximum Thrust)[5] (ft.) (above mean sea level)	>50,000	≥50,000	52,100	52,000
Carrier Suitability[6]				
Launch Catapult wind over deck; C-7 catapult; max. takeoff gross weight[7] (kts)	≤25	<30	29.9	29.1
Recovery: wind over deck[8] (kts)	≤10	<15	9	14
Approach speed[9] (kts)	≤140	<150	142	145
Recovery payload[10] (lbs,)	>9,000	≥9,000	9,125	9,500
Usable Load Factor[11] (g)	≥+7.5	≥+7.5	7.5	7.5
Specific Excess Power (Max.Thrust)[12] (fps.)	≥650	>600	644	642
Acceleration (0.8 Mach to 1.2 Mach @ 35,000 ft.)[13] (sec.)	≤60	<70	64	64
Additional Internal Fuel Capacity (over that of the F/A-18C/D) (lbs.)	≥3,000	≥3,000	3,828	3,613

Acronyms: Fps-feet per second, nm-nautical miles, sec-seconds, kts.-knots, ft-feet, lbs.-pounds, g-gravity force

Footnotes: See next page.

Explanations of Key Performance Parameter Characteristics

[1]The demonstrated performance is based on the recovery weight of the aircraft (30,564 lbs. for the F/A-18E, and 30,984 lbs. for the F/A/18F) plus the recovery weight of the crew, fuel that cannot be used by the aircraft, airborne self-protection jammer; engine fluids; gun; 400 rounds of ammunition cases; pylon stations 2,3,4,8,9, and 10; centerline pylons; wingtip launchers; nacelle ejectors; and chaff.

[2]A nondimensional number used to represent the operational deck space usage of the aircraft planning. A tool to optimize configuration of aircraft on the deck of the carrier. The base of 1.0 equals the size of A-7 (*Corsair*) aircraft.

[3]Aircraft in fighter escort configuration with no external fuel tanks (F/A-18E only).

[4]The distance attainable on a flight to the target and the return distance equal to that flown out. The aircraft is configured with defensive air-to-air ordnance plus air-to-ground ordnance.

[5]Altitude at which the maximum climb rate is 500 feet per minute.

[6]Tropical day conditions.

[7]The amount of wind blowing across the surface of the aircraft carrier, from bow to stern, needed to launch the aircraft at maximum weight.

[8]The amount of wind needed across the aircraft carrier to land the aircraft.

[9]The airspeed required to sustain level, unaccelerated flight on the glide slope in the approach configuration (full flaps, landing gear extended, tail hook down, approach angle of attack).

[10]The combination of unused ordinance and fuel that the aircraft is capable of bringing back to the ship.

[11]Factor of gravity forces.

[12]A measure of the aircraft's ability to change its energy state, such as climb, acceleration, or both.

[13]The time it takes to accelerate from 0.8 mach to 1.2 mach at 35,000 feet.

Appendix E. Exit Criteria for Third Low-rate Initial Production Decision

On March 26, 1997, the Defense Acquisition Executive approved the following six exit criteria for the third low-rate initial production (LRIP) decision.

Exit Criteria	Status as of January 1999
1. Complete fatigue testing.	Completed July 1998.
2. Complete engine full production qualification including accelerated simulated mission endurance test simulating 2000 hours hot section life.	Completed December 1998
3. Demonstrate carrier suitability:	Completed January 1997
• Launch Wind Over Deck <33 knots	
• Approach speed <153 knots	
• Recovery Wind Over Deck <18 knots	
4. Complete splice[1] on first LRIP aircraft.	Completed June 1998
5. Demonstrate LRIP I contract cumulative cost performance index of 0.9[2] at splice of LRIP I aircraft.	Completed June 1998
6. Complete Operational test phase:	
• IIA	Completed November 1997 Report Issued March 1998
• IIB	Completed August 1998 Report Issued November 1998

[1]Splice is the combining of the forward and aft fuselage.

[2]Measurement associated with the earned value management system.

Appendix F. Status Of Major Deficiencies

As of April 1999

Critical Operational Issue/ Major Deficiency	Status
Fighter Escort Mission:	
Poor climb performance above 30,000 feet	Resolved: Afterburner will be used.
Low tactical ceiling	Resolved: Afterburner will be used.
Low maximum velocity	Improved tactics will optimize performance.
Insufficient acceleration performance	Margin will be gained by improving weapon systems.
Combat Air Patrol Mission:	
Airframe buffet	Being studied. No operational impact.
Air Combat Maneuvering:	
High angle of attack agility and controllability	Software improvements being made.
Slow loaded energy addition rate	Software improvements being made.
Slow response to control inputs	Software improvements being made.
Slow roll performance	Software improvements being made.
Tactically ineffective sustained turn performance	Improved tactics will optimize performance.
Excessive energy bleed rates during maneuvering	Being studied. Significant improvements have been made.
Air-to-Ground Sensor Performance:	
Tactical forward-looking infra-red resolution and magnification	F/A-18C/D legacy issue. Advanced Tactical Forward-Looking Infra-Red program will resolve this issue.

Critical Operational Issue/ Major Deficiency	Status
Survivability:	
Radar warning receiver threats performance	Software and tactics being adjusted.
False radar warning receiver threats	Software improvement being made.
Limited Use towed decoy.	Resolved: Suitable envelope demonstrated.
Air-to Ground Weapons:	
Fin impacts tactical forward-looking infra-red	The Program Office is adjusting loads to compensate.
Cracks around the conical fin assembly access door corners	Resolved: New material and design.
Uncommanded low and high drag releases	Use of alternate external loadings will retain tactical effectiveness.
Missile coning	Load and release interval changed.
Air-to-Air Sensor Performance:	
Electronic attack deficiencies	F/A—18C/D legacy issue. Active Electronically Scanned Array program will resolve this issue.
Inadequate performance of vertical acquisition mode	F/A-18C/D legacy issue. Fix identified for incorporation into operational flight plan upgrade.
Air-to-Air Weapons:	
Insufficient capacity of the nitrogen bottle	Being studied. New missile will not require cooling.
Damage to missile assemblies caused by the wing tip environment	Resolved: Increased radius forward hangers.
Limited life of missiles flown on stations 2 and 10	Contractor procuring redesigned buttons.

Critical Operational Issue/ Major Deficiency	Status
Mobility:	
Inconsistent brake performance	Resolved. Corrected in manufacturing.
Imprecise and difficult trimmability	Improved through flight control changes.
Compatibility:	
Fuel HOT cautions during hot weather operations	Resolved. Software improvements made.
Safety:	
Difficulty stepping from the ladder to and from the leading edge extension	New material demonstrated.
Difficulty performing standard maintenance in the cockpit	Resolved. Grab handle installed.

Appendix G. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology
  Director for Test, Systems Engineering and Evaluation
  Director, Defense Logistics Studies Information Exchange
Under Secretary of Defense (Comptroller)
  Deputy Chief Financial Officer
  Deputy Comptroller (Program/Budget)
  Director, Program Analysis and Evaluation
Director, Operational Test and Evaluation

Department of the Army

Auditor General, Department of the Army

Department of the Navy

Assistant Secretary of the Navy (Financial Management and Comptroller)
Assistant Secretary of the Navy (Research, Development, and Acquisition)
  Commander, Naval Air Systems Command
  Program Executive Officer, Tactical Aircraft Programs
    Program Manager, F/A-18E/F *Super Hornet* Program
Auditor General, Department of the Navy

Department of the Air Force

Assistant Secretary of the Air Force (Financial Management and Comptroller)
Auditor General, Department of the Air Force

Other Defense Organizations

Director, Defense Contract Audit Agency
Director, Defense Logistics Agency
Director, National Security Agency
  Inspector General, National Security Agency
Inspector General, Defense Intelligence Agency

Non-Defense Federal Organizations and Individuals

Office of Management and Budget
General Accounting Office
  National Security and International Affairs Division
    Technical Information Center

Congressional Committees and Subcommittees, Chairman and Ranking Minority Member

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
House Committee on Armed Services
House Committee on Government Reform
House Subcommittee on Government Management, Information, and Technology, Committee on Government Reform
House Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform

Honorable Russell D. Feingold, United States Senate

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